CHAPTER - 4

SELECTION OF MACHINERY WITH SPACE,MANNING AND POWER REQUIREMENT FOR ALTERNATIVES AND THEIR BALANCING.

Introduction

This chapter determines the number of machinery required at sub-process levels for modern,intermediate, KVIC and traditional technologies. This is essential as the processing machinery of the alternative technologies vary with the production capacity, floor space, power consumption and the manning level. The assesment of the machinery requirement should also take into account the sufficient level of processed materials which has to be maintained at each sub-process level to avoid shortage. A balancing in the number of factory units for alternative technologies is essential ,for example, the comparable level of output (Q) is determined on the basis of the modern technology which could be produced in a single factory. Whereas, the same output could not be met by intermediate ,KVIC and traditional technologies in single factory unit . These technologies would require more than one unit to meet the comparable level of output. The input-output balancing of the units between the modern, intermediate and traditional technologies would ensure that the output of all twelve alternative technologies would give the comparable scale of output (Q).

Selection of Machinery

When the textile production is organised under factory-shed, it is of utmost importance that each sub-process produces a balanced output for the next process, i.e excessively surplus output or unutilised capacity in any sub-process level is not desired, This brings forth the notion of fully exploited technical economies of scale. The constraints of high capacities of the Opening and Cleaning ,Sizing and Warping machinery lie in their indivisibility,while the other sub-process machinery are fairly divisible, which suggest that the unit size with 2,5000 spindles would exploit the technical economy of scale, although, beyond this capacity there may be some management and administrative economy. The total investment cost(Chapter-2) may vary on the type of product selected (UNIDO -1967) and there may also be limitations on the range of products manufactured by the techlogies (Pack, 1976). The selection of machinery would therefore be based on these considerations. As stated earlier, the products are,intermediate output of 32s yarn count and the final output in the form of grey cloth with 54 picks and 54 ends construction. These are assumed to be produced with all the technologies without largely affecting the quality of the output. The selection of machinery would therefore,take into considera -tion the technical economy of scales , product type, sub-process level wastage, maintenance practice and on the surplus level of output in each preceeding sub-process level in order to accomodate any production loss due to machine break-down or other related failures. It is to be noted that the selection would be influenced as to whether the output is an intermediate or final product. If a unit is producing intermediate yarn to supply the handloom sector then additional sub-processes viz. Reeling ,Bundling and Bailing Press beyond the spinning section would be required in order to market the intermediate output. The composite units which produce grey fabric do not need these sub-processes. However, the sub-processes in the Traditional technology may not function identically to the modern sector.They may make very little use of equipment,but employ labour for certain tasks , such as, Warping . As it was considered to use alternative sources of machinery in the modern sector, it may arise that a single source of manufacturer for a complete process would not be available. In such circumstances, the sub-process machinery would be substituted by alternative manufacturers of the same country source at identical price.

Modern Sector Technology

The technical literature on modern sector contains information on speed, power and floor space requirement of the machinery and also the recommended level of effeciency on which these machinery can be operated. The spinning and weaving plan from the manufacturer specifies the levels of manning and recommended effeciency which can be expected from machinery at particular country condition. These information were collected from the manufacturers of alternative technology sources viz. UK, Japan, Rumania and India to construct a complete process machinery.

However, such information is more complete for spinning machinery than the weaving. This is because the development of the textile industry in Bangladesh had been emphasised on the expansion of spinning capacity **since** 1973. The information on weaving machinery, however, has been compiled from different sources and a complete composite technology has ultimately been constructed here.

Spinning Unit

The selection of machinery has been based on the expected capacity of the machinery which has been estimated from the maximum rated capacity and from an account of machinery effeciency as recommended by the manufacturer. The balancing of each sub-process level output is based on daily production. The number of spindles for the balancing of Blow-Room output has been estimated to be almost 25,000. As the information on spindle speed, expected effeciency and production are available the production in the spinning sub-processes can be calculated. From the spindle output and the quality of yarn, the net output required at each sub-process level can also be calculated taking into account the wastage level. Furthermore, the output level at each sub-process level need to take note of the output loss due to maintenance work and probable breakdown and over and above a provision for buffer output level should be there for maintaining a balance in the complete production process. The number of machine required at each sub-process level can be calculated from the required level of output. These have been calculated for alternative machinery sources viz. UK, Japan, Rumania and India and given in table 5.1. The table shows that the number of machinery for alternative sources vary at the sub-process levels ,for example, for Carding, the UK technology requires only 18 machines, whereas for Japan and India ,it is 20 and for Rumania 22 machines. The machinery for other sub-processes may also vary and is shown in table 5.1. The table also gives the installed power requirement for each machinery at the sub-process levels, from which the total installed power is calculated

TABLE 5.1

PRODUCTION PLAN(SPINNIG AND WEAVING)

(Based on Manufacturer's Recommended Production at 32s Cotton Count)

Source	Machine Details	SPINNING									WEAVING				
		Blow-Room	Carding	Drawing	Roving	Spinning	Cone Winding	Reeling	Bundle Press	Bailing Press	Cone Winding	Pirn Winding	Warping	Sizing	Loom
UK	Rated Capacity(oz/s)	11,440	500	3,850	12.18	4.55	13.00	500	1,000	15,000	13.00	13.50	10,000	12,000	41.90 yds
	Recommended Eff.(%)	80	80	75	90	90	85	80	80	60	85	85	75	70	90
	Expected Prodn.(lbs/s) a/	9,150	448	2,890	11.52	4.09	11.05	400	1,250	9,000	11.05	11.47	7,875	8,400	37.05 yds
	Daily Prodn.(3S(lbs)) a/	27,450	24,192	26,000	24,330	18,795	25,530	24,000	23,040	27,000	25,530	10,740	23,620	25,200	79,600 yds
	Daili Required Prodn.	20,550	19,950	10,500	19170	18,795	18,610	18,520	18,330	18,330	18,350	9,000	9,210	9,120	79,565 yds
	No.of M/C or Spindle	11/2S	18	3x2 =6	88x8=704	24,960 b/	110x7=770	20	6	1	110x7=770	26x12=312	1	1	725
	Insallwed Power M/c(kw)	123	8.4	8	19	15.25	8	1	1.5	15	8	2.5	16	21.05	3
	Total Power(kw)	123	151.2	48	152	949	56	20	9	15	56	65	16	21.95	2.175
JAPAN	Rated Capacity(oz/s)	9,860	450	3,700	11.30	4.48	13.50	500	1,000	15,000	13.50	13.00	9,400	10,720	37.05 yds
	Recommended Eff.(%)	90	85	80	85	90	85	80	80	60	85	85	75	70	90
	Expected Prodn(lbs/s)	8,570	382	2,900	9.60	4.04	11.47	400	1,250	9,000	11.47	11.05	7,050	7,500	33.36 yds
	Daily Prodn.(3S(lbs))	20,620	22,950	26,040	22,120	18,530	24,770	24,000	23,040	27,000	24,770	11,140	21,150	22,500	79,570 yds
	Daily Required Prodn.	20,260	19,665	19,280	18,900	18,530	18,350	18,260	18,170	18,170	18,350	9,000	9,210	9,120	79,565
	No.of M/C or Spindle	11/2S	20	3x2 =6	96x8=768	24,960 b/	120x6=720	20	6	1	120x6=720	28x12=336	1	1	825
	Installed Power M/c(kw)	100.5	6.6	6.75	15	15	12.5	1	1.5	15	12.5	2.25	15	17.3	3
	Total Power(kw)	100.5	132	40.50	120	750	75	20	9	15	75	63	15	17.3	2.475
INDIA	Rated Capacity(oz/s)	9,500	440	2,000	10.45	4.48	13.00	500	1,000	15,000	13.00	12.00	8,000	9,500	39.52 yds
	Recommended Eff.(%)	85	90	85	85	90	85	80	80	60	85	80	75	70	90
	Expected Prodn.(lbs/s)	8,080	396	2,120	8.90	4.04	11.05	400	1,250	9,000	11.05	9.60	6,000	6,650	35.57
	Daily Prodn(3S(lbs))	24,225	23,760	26,520	23,070	18,530	23,870	24,000	23,040	27,000	23,870	11,060	18,000	19,950	79,610 yds
	Daily Required Prodn.	20,260	19,665	19,280	18,900	18,530	18,350	18,200	18,170	18,170	18,350	9,000	9,210	9,120	79565 yds
	No.of M/C or Spindle	1L/2S	20	4x2 =8	108x8=864	24,960 b/	120x6=720	20	6	1	120x6=720	32x12=384	1	1	775
	Installed Power/M/c	90.5	5.6	5.4	13	15	12.4	1	1.5	15	12.4	1.5	13.5	16.5	3
	Total Power(kw)	90,5	112	43.2	106	967	74.4	20	9	15	74.4	48	13.5	16.5	2.325
RUMANIA	Rated Capacity(oz/s)	9,290	392	2,550	10.45	4.45	12.00	500	1,000	15,000	12.00	I	I	I	I
	Recommended Eff.(%)	90	90	85	85	90	85	80	80	60	85	I	I	I	I
	Expected Prodn.(lbs/s)	8,360	353	2,170	8.90	4.01	10.20	400	1,250	9,000	10.20	I	I	I	I
	Daily Prodn.(3 shift)	25,080	23,300	26,120	23,070	18,540	23,090	24,000	23,040	27,000	23,090	11,060	18,000	19,950	79,610 yds
	Daily Required Prodn.	20,270	19,675	19,290	18,910	18,540	18,360	18,265	18,170	18,170	18,350	9,000	9,210	9,120	79,565 yds
	No.of M/C or Spindle	1L/2S	22	4x2 =8	72x12=864	25,056 c/	96x8=768	20	6	1	96x8=768	32x12=384	1	1	775
	Installed Power/M/C(kw)	92	5.15	4.5	3	18.6	13	1	1.5	15	13	1.5	13.5	16.5	3
	Total Power(kw)	92	113	36	36	972	104	20	9	15	104	48	13.5	16.5	2,325

Note: a/ S or s : Shift; b/ 480 spindles/frame and 52 frames; c/ 432 spindles/frame and 58 frames.

SOURCE: Manufacturer's Literature and Textile Mills Corporation,Bangladesh.

The Ring-finishing machinery viz. Bailing and Cone-Winding, Reeling are/~~also~~ not available from all alternative sources. It has been found that the Reeling machinery are available from the local manufacturer, while the Bundle and Bailing Press have mainly been supplied to the BTMC from the Indian source. Therefore, the sources of these machinery would be assumed accordingly and be identical*/ The Cone-Winding machinery was not available from the UK source and had to be substituted from the French. This was based on the broad assumption that if machinery sources from UK if not available then they would be substituted by Western Europe or North American sources. Air-conditioning machinery for all alternative supply sources have been assumed to be identical as the machinery available from alternative sources vary considerably in technical specification. For some sources, only the air-conditioning of the spinning section has been recommended , while for the Indian source, a partial humidification of the plant has been suggested.

*for all modern technologies

Space Requirement

The total space requirement of different sources of technology would vary according to the floor-space area required by the machinery. The lay-out of the machinery has been based on the spinning plan of the BTMC. The factory areas of the UK, Japanese, Rumanian and Indian technologies have been calculated and given in details in appendix 5.1. The appendix shows that the Indian machinery requires a factory size with minimum floor space of 8,010 sq. metres, which increases progressively for Japan, Rumania and UK from 8,195 to 8,226 to 8,338 sq. metres respectively. The difference in floor space requirement for alternative machinery sources was found to be very small i.e in the range of 4 per cent.

Appendix 5.1 also shows other building areas such as the wareshouse,workshop,office and residential accomodation. The textile mills constructed under the public sector includes residential accomodation for some administrative and managerial staff. No house-rent is therefore required to be paid to them. The accomodation facilities are provided as it is often difficult to find suitable accomodations in the vicinity of the work place. The building areas for warehouse, workshop, office and residential and other structures have been taken to be the same across the technologies, they are 1,880 and 1,907 sq. metres respectively.

Manning Level.

Operatives at different sub-process levels have been estimated from the manning level observed from a survey of 16 textile mills in Bangladesh using machinery from UK, Japan, Rumania and India. The observed manning was found to be much higher than the recommended level, for example , the UK manufacturer had recommended a total employment of 194 for production maintenance operatives and administrative personnel, whereas in Bangladesh the total employment was found to be almost 5 times higher i.e around 972 employees. The details of the sub-process employment for UK, Japan, Rumania and India are shown in appendix 5.2, table 5.2 shows a comparative employment level of all these technologies. Table 5.2 decomposes the total employment into direct production and maintenance personnel with their skill composition and administrative and managerial staffs. It shows tha the skill requirement across the alternative are not significantly different except for semi-skilled workers. Rumania provides the highest direct employment of 724 because of its large labour-force employed at the spinning section, followed by Indian, Japanese and UK technologies of 686, 677 and 665 respectively. In Bangladesh, the spinning tenter known as 'Double Sider' operates on both sides of the spinning frame, therefore, the spindles per operatives vary according to the number of spindles per frame. The number of spindles per frame of the UK, Japanese and Indian technologies are identical i.e 480 spindles, while for the Rumanian machinery ,it is 432. The total requirement of maintenance workers is determined by the number of machinery. It has been found that Rumanian and Indian technologies require identical number of maintenance workers of 87, while the UK and Japanese require 72 and 74 respectively. The

TABLE 5.2

COMPARATIVE MANNING LEVEL OF UK,JAPANESES,INDIAN AND RUMANIAN TECHNOLOGIES(SPINNING)

Technology Sources	S[a]	SS[b]	US1[c]	US2[d]	Total	S	Types of Operatives SS	US1	US2	Total	S	SS	US1	US2	Total	Admin. & Others	Total
U.K	20	542	19	84	665	12	13	18	29	74	10	10	9	1	30	205	972
JAPAN	20	554	19	84	677	13	14	18	27	74	10	10	9	1	30	205	986
INDIAN	20	560	19	88	686	15	17	20	35	87	10	10	9	1	30	205	1,008
RUMANIAN	20	594	19	91	724	15	17	20	35	87	10	10	9	1	30	205	1,046

Note : a/ S = Skilled
b/ SS = Semi-Skilled
c/ US1= Un-Skilled(type-1)
d/ US2= Un-Skilled(type-2)

Source: From a survey of 18 textile mills in Bangladesh using UK,Japanese,Indian and Rumanian machinery.

total requirement of workshop personnel is 30 and is identical for all the alternative technology sources as the all the workshop types have been assumed to be the same.

The requirement of the administrative personnel of all the technology sources have been taken to be identical. This poses no problems as the size of the spinning units of all the machinery sources are almost the same. In fact,the BTMC practices a standard administrative and managerial set-up for textile mills with identical capacites. However, the strength of administrative and managerial staff for UK technology was found to be five times higher than the manufacturer's recommendation. This was due to a sizeable proportion of non-administrative staff viz. security guard, peon,garderner ,etc who are included in the category of adminstrative personnel.

Power Requirement

The technical literature on alternative machinery sources contain information on installed power for each machinery. The total installed power requirement could be estimated from these sources,however, as already discussed in details in Chapter-4 the observed power consumption is not necessarily the total installed power. An absorption factor is therefore required for the count of yarn chosen. The absorption factor for 32s yarn count can be calculated from figure 4.6. An absorption factor of 0.8 is required for pre-spinning and ring-finishing machinery, while a factor of 0.69 is required for the spinning sub-processes separately. Using these factors, the absorbed power for alternative sources of machinery can be calculated. Appendix 5.3 shows the installation,absorption and lighting power requirement of UK,Japanese, Rumanian and Indian technologies.

It is clear from the table that the UK technology requires the highest installed and absorbed power followed by Indian,Rumanian and Japanese spinning technologies. The total annual power consumption of UK,Indian, Rumanian and Japanese spinning technologies are 10.06m, 9.61 m, 9.39 m and 8.85 million respectively.

The total consumption includes air-conditioning,lighting, power pump and miscellaneous consumption of 215 Kwh which is assumed to be identical across the technologies. Lighting has been estimated to be 1 Kwh/150 sq. metre. It, therefore,shows that UK consumes about 4.7, 7.1 and 13.65 per cent more power than the Indian,Rumanian and Japanese technologies respectively.

Composite (Spinning and Weaving)Units

The selection of machinery for the composite units has followed the same procedureaas for spinning,i.e based on the recommended effeciency,expected capacity and sub-process level wastage . However, in this case the emphasis was that the intermediate yarn which is the output of the spinning process would be used totally to produce grey cloth. As the wastage level of all the preparatory and weaving sub-processes are known, it is possible,therefore, to calculate the amount of material required to be processed and the number of machinery required at each sub-process level. Table 5.1 shows the number of weaving machinery required for UK, Japanese,Rumanian and Indian technologies along with their installed power requirements.

The table shows that the alternative sources of technologies require different numbers of machinery for the sub-processes, for example UK and Japan require 725 and 825 looms respectively to produce a comparable scale of output (Q) . The number of looms required by the Indian and Rumanian technologies are identical and is 775. The Japanese loom has lower production than the Indian. This does not indicate the superiority of the Indian looms,rather the price quoted for the Japanese looms by the local supplier had lower production capacity .

It has been mentioned earlier that a single source of machinery may not be available for a complete production process. This constraint became more pronounced in the case of weaving machinery when faced with difficulty in obtaining adequate information in Bangladesh. To overcome this shortfall in information sources ,certain assumptions were made to help construct a complete composite technology for UK,Japanese,Indian and

Rumanian technologies.For these sources the problem was not so much with spinning as with weaving machinery. It is possible to construct a complete textile process for Japanese and Indian technologies,from the same country source if not from the same manufacturer. The problem becomes quite acute for the UK and Rumanian technologies. For UK weaving,except for the automatic looms, the Cone-winding machinery was substituted by French machinery (as in spinning),while Warping,Sizing and Pirn-winding machinery by North American source. 1/ Information on USA and French preparatory machinery was obtained from the local machinery supplier in Bangladesh and from the BTMC. As regards Rumanian technology, no information could be found on preparatory weaving machinery or looms either from the local supplier or the country source itself. 2/ It has therefore been assumed that except for Cone-winding machinery, the other preparatory and weaving machinery would be substituted from the Indian sources because of their similarities in technical features and prices. A comparative price co-efficient has been estimated to adjust the Rumanian preparatory and weaving machinery prices.

The other noteworthy assumption that has been made for weaving machinery for alternative technology sources concerns Twisting, Drawing and Reaching-in,Cloth Inspection machinery, Bailing Press and Boiler . These machinery are not available from a single manufacturer or from the same source and therefore, has been assumed to be supplied from the sources shown in appendix 5.4.

All the sources of machinery could supply Twisting machinery, however,its use is limited . It is required for doubling yarn for selvedge of the grey cloth. For each source 2 Twisting machinery were selected with 480 spindles each, except for Rumanian machinery which has 432. Drawing and Reaching-in and Cloth Inspection machinery have been assumed to be identical for all the technologies and the source has been considered to be Japan. The supply of these machinery to Bangladesh is only from Japan and is therefore the sole source of information. 3/

Finally,Bailing Press and Boiler have been assumed to be the same for all machinery sources and the source of supply has been considered to the Indian as they are sole supplier to the BTMC.

Space Recuirement

Appendix 5.5 shows the space requirement of the weaving section which includes areas for preparatory weaving section, loom-shed and cloth finishing section. Other building areas such as the Boiler house,stores, workshop,office and residential building areas have been calculated separately. These areas mostly include extensioon of the spinning areas, except for the Boiler house which has to be built for a composite unit. The total area of the composite units comprises of the entire spinning unit area excluding the space required for ring-finishing (see appendix 5.1) and 'other' building areas for spinning in addition to the total weaving area as mentioned above. Appendix 5.5 also shows the total space requirement of UK,Japanese,Indian and Rumanian composite technologies.

The UK technology requires the least weaving area of 8,570 sq. metres ,while the Japanese requires the highest area of 8,965 sq. metres. The area required by Indian and Rumanian technologies have insignificant difference between them and are 8,805 and 8,895 sq. metres respectively. This is because the Rumanian weaving sub-processes have been substituted by the Indian machinery except for the Cone-winding machinery. The differential between factory areas for alternative sources of spinning and weaving are almost the same and is 4.4 and 4.0 per cent respectively. The total composite unit area required for the Japanese technology is 20,175 sq.metres which occupies the largest space. While the difference in the total area between Indian,UK and Rumanian technologies are insignificant and they are 19,762, 19,877 and 19,977 sq.metres respectively.It, therefore,shows the differential between the total areas among alternative technology sources are small and varies by only 2 per cent.

Manning Level

The manning level for preparatory and weaving machinery has been estimated from a survey of five composite mills in Bangladesh. All the composite units use Japanese machinery because preparatory machinery from no other sources were installed since 1950,therefore the manning level for alternative sources of technology was based on this technology. A detailed sub-process manning level of all the technology sources has been given in appendix 5.6. It shows that a weaver operates 8 looms and this applies for weaving machinery from all technology sources. Table 5.3 gives a comparative manning level of the weaving section and of the composite units for UK, Japanese,Indian and Rumanian technology sources.

The table shows that the skill requirement of the alternative sources of technologies are only significant for unskilled labour For weaving section, UK technology has the lowest direct employment of 801,while Indian,Rumanian and Japanese technologies share almost the same levels i.e 864, 867 and 870 respectively. The overall variation between the highest (Japan) and the lowest (UK) employment levels for the technologies is only 8 per cent. Japan has the highest employment because of the higher number of looms used by the Japanese technology. The requirement of maintenance workers varied in the similar manner between 61 to 68, and once again the differential between the UK and the Japanese technologies was significant i.e 10 per cent while very little variation was observed between the other technologies. The number of additional workshop and administrative and managerial personnel are identical for sources of technology and are 10 and 33 respectively. The low level of employment of these categories is because the extension from spinning to the composite units entails relatively less additional staff for production and maintenance works.

Table 5.3 also shows the total employment required by the composite units of all the technology sources. It shows that the UK still remains the technology which provides the lowest employment

TABLE 5.3

COMPARATIVE MANNING LEVEL OF UK,JAPANESE,INDIAN AND RUMANIAN TECHNOLOGIES(WEAVING AND COMPOSITE)

Technology Sources	S[a]	SS[b]	US1[c]	US2[d]	Total	Types of Operatives S	SS	US1	US2	Total	S	SS	US1	US2	Total	Admin. & Others	Total
						WEAVING SECTION											
UK	57	451	141	152	801	19	14	12	16	61	4	1	4	1	10	33	905
JAPANESE	63	505	132	170	870	22	16	13	17	68	4	1	4	1	10	33	981
INDIAN	60	493	153	158	864	21	16	13	16	66	4	1	4	1	10	33	973
RUMANIAN	60	496	153	158	867	21	16	13	17	67	4	1	4	1	10	33	977
						COMPOSITE UNIT											
UK	72	779	144	204	1,199	29	25	27	41	122	14	11	13	2	40	238	1,599
JAPANESE	78	839	135	222	1,274	33	28	28	43	132	14	11	13	2	40	238	1,684
INDIAN	75	833	156	214	1,278	33	31	29	48	141	14	11	13	2	40	238	1,697
RUMANIAN	75	867	156	217	1,315	33	31	29	49	142	14	11	13	2	40	238	1,735

Note : a/ S = Skilled
b/ SS = Semi-Skilled
c/ US1 = Un-Skilled(type-1)
d/ US2 = Un-Skilled(type-2)

Source: From a survey of 18 textile mills in Bangladesh using UK,Japanese,Indian and Rumanian machinery.

of 1,599 followed by Japan,India and Rumania of 1,684, 1,697 and 1,735 respectively. Therefore, the Rumanian provides 8.5 per cent more employment than the UK technology. The skill composition of the composite technologies varies only significantly for the semi-skilled labour ,while for the skilled ,they are small . Rumanian technology has the highest production and maintenance employment of 1,315 and 142 followed by Indian, Japanese and UK technologies of 1,278 and 141, 1,274 and 132 and 1,199 and 122 respectively. The workshop and administrative and managerial staff required across the technologies have been assumed to be identical and are 40 and 238 respectively.

Power Requirement

The total installed power for the composite technologies has been found by combining the installed power for the spinning and the weaving sections . It has been assumed from the previous mentioned works of Catling and De Barr and from the consultations held with the manufacturer that an adjustment factor of 0.8 would be reasonable estimate for load factor across the preparatory and weaving sub-processes. The installed and absorbed power for preparatory and weaving sections have been calculated and are shown in appendix 5.7.

For the weaving section,the Japanese has the highest annual consumption of 17.11 million Kwh followed by the Rumanian and the UK technologies of 16.29 and 15.35 million Kwh respectively. India has the lowest consumption of 15.08 million Kwh. The total annual power consumption of the UK,Japanese, Indian and Rumanian composite technologies are 25.39 m, 25.89 m, 24.62 m and 25.62 million Kwh respectively. [illegible] Japan has emerged as the highest consumer of power having 1.1, 2.25 and 5.1 per cent more power requirement than the Rumanian,UK and India[illegible] technologies.respectively. Higher power consumption of the Japanese technology is because of its loom capacity which is 50 more than the Indian and Rumanian and 100 more than the UK technologies. The total power consumption includes air-conditioning (spinning),humidifiers(weaving),lighting, power pump and miscellaneous consumption. These, however,are taken to remain constant across the technologies.

INTERMEDIATE TECHNOLOGY

Unlike the modern technology,the information for the intermediate technology related to machine speed, expected production, recommended effeciency, manning level, floor space and power requirement are scarce. Most of these information used have been based on direct observation and personal surveys. The RFC and the ATDA use almost the same kind of re-built machinery. The essential difference lies in the type of spinning frames used by these technologies. The ATDA Service Centre supplies Roving to the pedal spinners, whereas the RFC technology process Roving under the same factory-shed using power spinning. If the ATDA uses its spinning frame with electric motor then these technologies are hardly differentiable except that the productions are organised at different levels. However, the proposed technology which the ATDA has aspired to develop for the cottage spinning is still in the developing stage,therefore, the technology considered is the one in practice at Kushmi Kalan,India and which is almost identical to the RFC (Coimbatore) technology.

The selection procedure for sub-process machinery considers wastage level, maintenance time, unanticipated production loss due to machine break-down and a provision for buffer output at each sub-process level for final balancing. It minimises the under-utilization capacity at the sub-process levels i.e optimises the technical economy of scale. However, the constraint lies in the excess production capacity of the Opening and Cleaning machinery,whereas the other machinery are quite divisible in compared to modern technology.

RFC Spinning and the ATDA Service Centre(Roving)

The selection of machinery has been based on observed production capacities which were achieved at Indian conditions and can be considered as the expected capacities of the sub-process machinery. It was found in India , that a central unit supplies cotton laps to five RFC units. There is no operational difficulty in transferring laps from the central Opening and Cleaning (Blow-Room) unit to the spinning unit except for some extra cost for transportation. The intermediate spinning unit production is balanced with the modern spinning unit. The number of machinery required has been ascertained on the basis of the material to be processed which can be calculated by taking into account the wastage level and other allowances mentioned earlier. Unlike the modern sector,the RFC spinning units do not have Bailing Press as these units are located near the handloom concentrated areas and the yarns are marketed directly in bundle forms. The selection of the number of machinery required for RFC and the ATDA technology and their observed production effeciency and capacity is shown in table 5.4. It can be calculated from these capacities that 20 RFC or ATDA units would be required to meet the comparable scale of output(Q).

The ATDA technology comprises of sub-processes upto Roving. Therefore, the production capacities and machinery requirements shown in table 5.4 would be identical for RFC and the ATDA technologies upto the Roving sub-process. In the ATDA technology, the output,'roving' would then be distributed to the pedal spinners at the village level for spinning. It is essential to ascertain the per spindle production of the pedal spinning (Charka) to establish the total number of Pedal Charkas needed to spin the output (roving) of a ATDA central unit. A survey has been carried out in India with twelve spinners which is given in appendix 5.8.

The survey shows that the weighted mean production per spindle of the Pedal Charka is 2.58 oz. It has then been calculated that about 542 pedal spinning frames would be required each with 12 spindles i.e 6,504 spindles to convert roving to yarn for a single ATDA Service Centre . Therefore, the total capacity required for 20 units is 130,080 spindles.

In RFC technology, the complete spinning process will be carried out under the same factory-shed,therefore all the machinery shown in table 5.4 would be required. The selection of machinery for the sub-process,'Drawing' would consider three identical operations for the processing of the same material.

TABLE 5.4

Intermediate Technology

Balancing of the Production Plan (Spinning) — No of Units: 20

(All in lbs, if otherwise stated)

	Blow-Room	Carding	Drawing	Rovings	Spinning (RFC Power)	Spinning (Pedal Charkha)	Cone winding	Reeling	Bundle Press
Rated Capacity (lbs/shift/spindle/machine)	7,000	160	225	8.6	3.450	3.06	10	500	1,600
Observed Efficiency (per cent)	70	70	70	70	80	84	70	80	75
Actual or Observed Production/shift	2,334	112	157	6.02	2.76	2.58	7	400	1,200
Required Daily Production (300 days)	1,120	1,070	1,035	1,015	995		985	980	975
Machine Requirement Based on 3 shift									
No. of Machines (or spindles)	1/5	4	3x3=9	1x70=70	48x42 = 2,016	542x12 = 6,504	28x2=56	1	1
Production Capacity	1,400	1,344	1,584	1,265	1,163	1,050	1,176	1,200	1,200
Power									
Installed Power (kw)/Machine	15.0	2.25	0.75	3.0	1.5		1.5	1.0	1.5
Total Installed Power (3 shift)	15.0	9.0	6.75	3.0	63		3.0	1.0	1.5

Source: Own survey from the ATDA (Kusmi Kalan) and the Rural Fabric Centre (Coimbatore), India.

(see appendix 4.X) . In fact, the modern technology'Drawing' has two operations which for intermediate should also produce similar product. However, an extra process for the intermediate technology would ensure a more uniform quality of yarn. The number of spindles required per RFC power spinning unit proposed in this study is found to be 2,016 i.e 40,320 spindles for 20 such units. The unit capcity found here is higher than the Indian RFC power spinning unit which had spindle capacity of 1,000. This is because about half of the production of the Indian Carding section is transferred to hand-operated spinning.

Space Requirement

Appendix 5.9 shows the space areas required for the RFC Spinning (stages I+II+RF) and spinning for composite unit(Stage I+II),ATDA Service Centre(Stage I)and the estimated workshed for the pedal charkas. The total unit area comprises of the factory building,workshop, stores and office and residential accomodation. The residential buildings are for some managerial and administrative staff . The table shows that the total area of the RFC spinning unit and the ATDA Service Centre are 26,180 and 13,800 sq. metres respectively. However,if the pedal spinning area is included with the ATDA Service Centre than the total spinning area increases to 33.900 sq. metres. The space required for the spinning for the composite unit is 25,080 sq. metres which is less than the requirement of the RFC spinning unit because of the exclusion of the Ring-finishing operation. The other improtant aspect is that the intermediate spinning technology requires twice as much area as modern spinning in terms of both factory building and total area.

Manning Level

The sub-process manning level for individual and the total number of units of RFC spinning ,spinning for composite unit, ATDA Service Centre and ATDA Pedal Spinning are shown in appendix 5.10 Table 5.5 summarises the employment requirements for production and manitenance workers with their

TABLE 5.5

COMPARATIVE MANNING LEVEL OF ATDA(PEDAL) AND RFC(POWER) SPINNING TECHNOLOGIES

Employment Types	RFC(Power) Spinning (Stages I+II+RF) Employment S	SS	US1	US2	Total	Unit	Total Empnt.	RFC.Spg.for Composite Unit (Stages I+II) Employment S	SS	US1	US2	Total	Unit	Total Empnt.	ATDA Roving and Pedal Spg. (Stage-I and Stages II+RF) Employment S.	SS	US1	US2	Total	Unit	Empnt
Production																					
Blow Room	3	-	9	11	23	4	92	3	-	9	11	23	4	92	3	-	9	11	23	4	92
Spinning 1/	6	5	201	22	234	20	4,680	6	-	177	9	192	20	3,840	-	3	42	3	48	20	960
Maintenance																					
Blow Room	1	-	1	1	3	4	12	1	-	1	1	3	4	12	1	-	1	1	3	4	12
Spinning 1/	3	1	7	2	13	20	260	2	-	5	2	9	20	180	1	1	2	-	4	20	80
Workshop																					
Central 3/	5	1	2	1	9	5	46	5	1	2	1	9	5	46	5	1	2	1	9	5	46
Spinning	2	-	-	1	3	20	60	1	-	-	1	2	20	40	1	-	-	1	2	20	40
Management	-	-	-	-	14	20	180	-	-	-	-	14	20	280	-	-	-	-	14	20	180
TOTAL	20	7	220	38	299		5,430	18	1	194	25	252		4,490	11	5	56	17	103		1,510
															Pedal Spinner						10,840
																					12,350

Note: a/ S: Skilled; SS: Semi-Skilled; US1 & US2: Un-Skilled type 1 and 2.

1/ Manpower requirement given for RFC spinning unit includes sub-process from Blow-Room to Bundle Press; for spinning and composite unit from Blow-Room to spinning, while for ATDA unit from Blow-Room to Roving.

2/ Pedal spinning at cottage level: 1 spinner per 12 spindles Pedal Charka.

3/ An additional material handler is taken for each central workshop.

Source: Own survey on Khadi Centre(Ahmedabad & Calcutta), Rural Fabric Centre(Coimbator), India and Charka & Cottage Industires Organisation(Comilla), Bangladesh.

skill composition and managerial staff. Although,the manning level for all the technologies are identical as they use similar kind of machinery, a large contrast appears when the spinning technology is substituted by the Pedal Charka. It shows that the employment level of the ATDA Service Centre with Pedal Charka is 2.3 times higher than the RFC spinning unit. The employment levels of these technologies are 12,369 and 5.430 respectively. The employment level of the RFC composite unit spinning is 4,490 which is less than the RFC spinning unit due to the exclusion of the Ring-finishing sub-process. The skill composition classified according to the wages paid to the operatives which as assumed earlier would be at the lower spectrum of the modern sector wages and salaries.It,therefore, shows that the in ermediate technology has higher unskilled labour contents than the modern. Finally,the RFC Power and the ATDA Pedal spinning provide 5 and 12 times more employment than the modern spinning respectively.

Power Requirement

The power requirement of RFC spinning, RFC composite unit spinning and ATDA technologies have been calculated in terms of installed and absorbed power and shown in appendix 5.11 The installed power of RFC spinning and ATDA Service Centre has been adjusted by factors 0.74 and 0.8 respectively to estimate the aborbed power (See figure 4.6). The annual power requirement includes lighting and miscellaneous consumption for an individual as well as for a total of 20 units. Power requirement for lighting has been assumed to be 150 sq. metres per kw. which makes allowance for low consumption during the daytime.

The annual power requirement for a single RFC spinning and ATDA (Roving) factory unit are 0.56 and 0.18 million Kwh respectively. As the ATDA produces only Roving for the pedal spinners, it, therefore,has low power consumption. Compared to the modern UK, Indian, Rumanian and Japanese spinning technologies, the RFC spinning technology has between 1.12 to 1.27 times more power consumption.

Composite Unit (Spinning and Pedal and Power Looms)

The intermediate composite unit under the same factory-shed of the type found in India is considered here i.e the RFC composite unit. In the RFC composite unit,only pedal looms were used. In the present study both pedal and power looms are combined with 20 spinning units to obtain the comparable scale of output (Q). The procedure for selecting machinery in the modern sector has also been applied in choosing machinery for composite units, that is, the output of the spinning has been processed for each of the units to produce grey cloth. The sub-process machinery for the preparatroy weaving are fairly divisible ,and,therefore, the problem of underutilised capacity is not so crucial. Table 5.6 shows the number of machinery required at the preparatory sub-processes along with the number of power and pedal looms essential to balance a unit. Twenty such units would meet the comparable level of output (Q).

The pedal loom production has been estimated from the RFC (Coimbatore) and the ATDA (Kushmi Kalan),however the construction of cloth has to be converted to the type selected for this study. The types of pedal looms are the same for these two units, but in the case of RFC units the looms are placed in a factory-shed under the same premises, while the ATDA looms are placed in the cottage levels. Appendix 5.12 (Page)shows the per shift production of pedal looms. It also shows that the production of pedal looms varies for RFC and ATDA technologies. For the purpose of making estimates, the weighted mean production has been calculated to be 11.25 yards per shift. It has been assumed that under Bangladesh condition, the pedal loom will achieve this production level. 3A/ With this calculated production,the number of pedal looms required for each unit has been calculated to be 550 per unit i.e 11,000 pedal looms are required to meet the output level (Q). As the power looms are locally available, their rated production (table 5.6) was based on the loom speed supplied by the manufacturer. The expected production was estimated from the average loom effeciency observed in the five

TABLE 5.6

Intermediate Technology

Production Plan of Weaving — No. of Units: 20

(All in Lbs.)

	Cone Winding	Pirn Winding	Sectional Warping	Sizing: Quantity (lbs.)	Sizing: No. of Beams (700 yds.)	Pedal Looms	Power Loom
Rated Production (lbs/shift/spindle or machine)	10.0	8.5	440	540	9.6	13.94 1/	32.0
Observed Effeciency (per cent)	70	70	70	65	65	80	75
Actual or Observed Production/shift	7.0	6.95	308	35[illegible]	6.25	11.25	24.0
Required Daily Production (300 days)	985	482	493	488	9	5,570 yds	5,570 yds
Machine Requirements							
Based on 3 shifts							
No. of Machines (or Spindles)	28x2=56	8x4=32	1	1	-	550	90
Production Capacity	1,176	572	924	1,053	19	6,188	6,480
Power							
Installed Power (Kw)/Machine	1.5	1.0	1.5	2.0	-	-	1
Total Installed Power (3 Shift)	3.0	4.0	1.5	2.0	-	-	90

1/ Pedal loom survey is based on 10 pedal loom weavers in India.

SOURCE : ATDA (Kushmi Kalan), Rural Fabric Centre (Coimbatore) and Technical literatures of the manufacturers.

private sector weaving mills in Bangladesh. It was found to be 24 yds, per shift per loom and accordingly 90 power looms would be required per unit to weave all the output into grey cloth. Therefore, a total of 1,800 power looms would be required for 20 units to meet the comparable scale of output(Q).

Space Requirement

The space requirement of the Pedal or Power loom composite units comprises of areas for spinning for composite unit and Power or Power loom areas correspondingly. The space required for individual and the total number of RFC composite units with Pedal and Power looms are shown in appendix 5.13 It is to be noted that while the Pedal loom runs on one shift basis, the power loom runs on a three shift basis, this is reflected in the 3.25 times the required floor space for the Pedal loom. The single factory unit area for Pedal and Power loom weaving are 4,280 and 1,325 sq. metres respectively. The total area for 20 Pedal and Power loom weaving units including the store, office and residential buildings have been estimated to be 87,300 and 27,100 sq. metres respectively. The total area required for the composite (spinning and weaving) Pedal and Power looms are 115,680 and 55,480 sq. metres respectively. In contrast to the modern composite unit, the Pedal and Power loom composite units require 5.75 and 2.75 times more floor space respectively.

Manning Level

There are no parallel RFC and ATDA technologies operating in Bangladesh , therefore their manning requirement is estimated from the Indian manning level. Each Pedal loom requires one weaver, whereas as observed in the private sector weaving one weaver can operate two Power looms. Appendix 5.10(page) shows the manpower requirement of the Pedal and Power loom weaving at different sub-process levels. Table 5.7 shows the employment in terms of production and maintenance workers with their skill composition and for managerial and administrative staff.

TABLE 5.7

MANNING LEVEL OF RFC WEAVING AND COMPOSITE UNIT

Types of Employment	PEDAL LOOM Employment[a] S	SS	US1	US2	Total	Unit	Total Employment	POWER LOOM Employment S	SS	US1	US2	Total	Unit	Total Employment
WEAVING SECTION														
Production	5	9	42	589	645	20	12,900	6	6	169	53	234	20	4,680
Maintenance	4	3	1	6	14	20	280	3	3	4	5	15	20	300
Workshop	2	-	-	1	3	20	60	3	-	1	1	5	20	100
Management	-	-	-	-	11	20	220	-	-	-	-	9	20	180
TOTAL	11	12	43	596	573	20	13,460	12	9	174	59	263	20	5,260
COMPOSITE UNIT														
Production	14	9	228	609	860	4/20 [b]	16,832	15	6	355	73	449	4/20	8,612
Maintenance	7	3	7	9	26	4/20	472	6	3	10	8	27	4/20	492
Workshop	8	1	2	3	14	4/20	146	9	1	3	3	16	4/20	186
Management	-	-	-	-	25	4/20	500	-	-	-	-	23	4/20	460
TOTAL	29	13	237	621	925	(897.5)[c]	17,950	30	10	368	84	492	(487.5)	9,750

Note: a/ S: Skilled; SS: Semi-Skilled; US1 & US2: Unskilled type 1 and 2.
b/ 4 Openning and Cleaning(Blow Room)Units & 20 Composite Units
c/ Average employment per composite unit.

Source : Own survey on 5 private weaving mills,Bangladesh and RFC composite unit(Coimbatore),India.

The table shows that the per unit manning level of Pedal and Power loom weaving are 673 and 263 respectively, i.e the Pedal loom weaving requires 2.6 times more manning than the Power loom. The corresponding employment for the 20 units are 13,340 and 7,860 respectively. The unit employment of the Pedal and Power loom composite units are 900 and 487 respectively, i.e for 20 units the total manning level are 17,950 and 9,750. Therefore, the RFC composite unit Pedal loom requires about 1.84 times more employment than the Power loom. Their requirement of unskilled labour is relatively higher than the modern composite units. The explanation to this has already been provided in the RFC spinning. The administrative and managerial staff of the Pedal and Power loom Composite units are 25 and 23 per unit respectively. Although the strength of the administrative staff of the intermediate technology is comparatively smaller than the modern sector ,however, its organisation structure is less complex. In india a factory with 200 employees is run by a single manager and three administrative staff.

Power Requirement

The installed and absorbed power requirement of the RFC composite unit with Pedal and Power looms are shown in appendix 5.11(See page 2)The absorbed power of the Pedal loom has been calculated by using an adjustment factor of 0.75 for spinning and pre-weaving ,while for Power loom ,the factors used are 0.74 and 0.8 for spinning and weaving respectively. The appendix shows that the annual per unit power requirement of the Pedal and Power looms are 1.19 and 0.64 million Kwh,while the total requirement of 20 units are 23.90 and 12.82 million Kwh respectively. The Power loom,therefore,requires twice as much power as the Pedal loom technologies. The power consumption of the Power loom composite unit would not be significantly different from the modern composite utechnologies in order to achieve the comparable scale of output(Q). The Indian,UK,Japanese and Rumaniar composite technologies consume between 3 to 7 per cent more power than the Power loom composite unit.

Service Centre

Before selecting the machinery,it is essential to determine the number and size of the Service Centre and the number of handlooms they would provide services to in order to achieve the comparable scale of output (Q). The ATDA Service Centre is at present operating on a trial basis and supplies only 10 handloom weavers. The Facility Centre presently operated by the Bangladesh Handloom Board only extend services like product development and cloth finishing. The setting-up of the proposed type of Service Centre with 40 weaving families in handloom concentrated areas has been suggested in a foreign agency report. 4/ Most importantly, it was suggested in a UNIDO report that a production and marketing cooperative could be established with 2,000 cottage weaver units located within a radius of five miles. 5/ This would include about 4,440 looms assuming the size of 2.22 looms per unit as found in the Handloom Census-1978. Therefore, a Service Centre could function in such a cooperative and provide services to 4,000 to 4,500 looms. Preliminary calculations show that this Centre should be able to supply 50 to 60 warp-beam per shift with warp length upto 350 yds. per beam. It has been shown later in this section that about 10,636 to 13,824 handlooms are required depending on their type viz. Pit or C.R looms to attain the comparable scale of output (Q). Therefore, three such Service Centres are required to supply processed warp-beam to these handlooms.

The selection of Service Centre machinery is based on production and effeciency of the sub-processes observed in the RFC and the ATDA units. The efficiency level ranges between 65 to 70 per cent and is assumed to be achieved under Bangladesh condition. From the comparable scale of output (Q),the quantity of yarn to be processed at each sub-process elevel can be calculated. The number of machinery required is calculated by accounting for the observed machine capacity,wastage level,maintenance time, unexpected breakdown and the level of buffer stock production for balancing the production process. The number of machinery determined is shown in table 5.8 . The table also gives the per machine requirement of installed power. It is to be noted that the sizing machine produces a beam of upto 1,500 yds.warp length. For handloom, the warp length should restricted between 250 to 350 yds. because of technical and economic considerations. The technical limitation arises due to the loom construction which makes it unsuitable to carry beyond 400 yds. of warp length, while the economic consideration concerned the difficulties faced by the weavers to raise the working capital required to buy the warp. 6/ To overcome this problem it is necessary to install handloom beam winding machinery which would transfer the large beam of warps to smaller beams. This is a simple and technically feasible procedure 7/ and such machinery could be designed and manufactured locally.

Space Requirement.

The space requirement of the Service Centre machinery is identical to that of the RFC pre-weaving. Appendix 5.14 shows the single unit and the total area required by the Service Centre which comprises of factory-shed, store, workshop and residential building. The factory-shed area required per unit is 683 sq. metres ,while the total area for a single unit is 1,143 sq.metres,

Manning level

The per shift manning level of each Service Centre machinery is identical to that of the RFC preparatory weaving. Appendix 5.15 gives the sub-process manning level of the Service Centre. Table 5.9 shows the administrative staff requirement and summarises the maintenance , workshop personnel with their skill composition.

TABLE 5.8

INTERMEDIATE TECHNOLOGY

PRODUCTION PLAN OF SERVICE CENTRE (All in LBS)

No. of Units: 3

	Hank to Cone Winding	Sectional warping	Sizing Qty. (lbs)	Sizing No. of Beams (1500 yds)	Handloom Beam Winding Machine
Rated Production (lbs/shift/spindle or Machine)	10.0	440	540	4.5	30
Observed Efficiency (per cent)	70	70	65	65	60
Actual or Observed Production/shift	7.0	308	351	3	18
Required Daily Prodn. (300 days)	3,120	3,085	3,055	27	136
Machine Requirements Based on 3 shift					
No. of Machines (or spindles)	28x7=196	4	4	-	3
Production Capacity	4,116	3,696	4,512	35	175
Power					
Installed Power (kw)/Machine	0.375	1.5	2.0	-	.75
Total Installed Power (3 shift)	2.625	3.0	8.0	-	2.25

Source: Own survey from the ATDA (Kusmi Kalan) and Rural Fabric Centre (Coimbatore), India.

TABLE 5.9

MANNING LEVEL OF SERVICE CENTRE

Types of Employment	S	SS	Employment[a/] US1	US2	Total	Unit	Total Employment
Production	3	36	58	84	181	3	543
Maintenance	4	2	3	6	15	3	15
Workshop	4	3	1	1	9	3	27
Management	-	-	-	-	15	3	45
TOTAL	11	41	62	91	220	3	660

Note: a/ S: Skilled ; SS : Semi-Skilled
US1 and US2 :Unskilled(type 1 and 2)

Source : RFC Composite Unit(Coimbatore) and ATDA Service Centre(Kusmi kalan), India.

Table 5.9 shows that a single unit requires a total employment of 220 which includes 181 for production and 15 each for maintenance and management and 9 for workshop staff.The total employment level for three units would be 660.

Power Requirement

The installed and absorbed power requirement of the Service Centre have been shown in appendix 5.16 . The Service Centre uses the same machinery as the RFC preparatory weaving and so its adjustment factor has been estimated accordingly. The annual power requirement per unit is 169.2 thousand Kwh i.e the total requirement of three units is 507.6 thousand Kwh. The lighting of factory units is taken to be 150 sq.metres per Kwh which is identical to other intermediate technologies.

KVIC Technology

The information on machine capacity, wastage level,floor space requirement and power consumption were partly obtained from the KVIC literature and the rest from the survey conducted in India and Bangladesh. In the production process, the pre-spinning machinery viz. Beater (the first Opener),Purbo Pesai (the second Opener), Carding and Uttar Pesai (Drawing) are only power driven. The selection of the number of Roving and Spinning frames would depend on the output of pre-spinning machinery.

The expected or the observed production capacity of the pre-spinning machinery are identical and has been established from the observation of units in India and Bangladesh.Difficulty is faced when the observed capacity of hand operated machinery are to be estimated because of variations in skill, location of the units and the quality of the input. To accomodate such variation,a survey involving interview of 67 spinners and 13 rovers in different parts of India and on a hand operated unit in Bangladesh,was carried out. Appendix 5.17 contains detailed information on the areas,types of products processed and their productivity level. This shows that the per shift weighted mean production of the Ambar Charka rover and spinner are 2.28 lbs. and 2.17 oz. respectively. The number of preparatory machinery and hand operated equipment required for KVIC spinning unit have been calculated based on their observed production and shown in table 5.10.

A combination of the KVIC spinning and the Handloom form an alternative technology. The KVIC spinning unit would supply the handloom weavers with yarn in a bundle form. This would require the extension of the sub-process operations Reeling(by Charka) and Bundle Press which were not included in the original KVIC technology. However,these stages of production are technically feasible and do not alter the technology. To obtain the comparable scale of output (Q) of the modern and the intermediate spinning,it has been found that 240 KVIC units would be required.

TABLE 5.10

Khadi and Village Industries Commission(KVIC) Technology

Balancing of the Production Plan(Spinning) No.of Units : 240

(All in lbs, if otherwise stated)

	Opening: Beater (Opener)	Opening: Poorva Pesai	Carding	Drawing (Uttar Pesai)	Roving: Ambar charka		Spinning: Ambar Charka		Reeling (By Charka)	Bundle Press
Rated Capacity(lbs/shift/spindle/machine	132	44	44	44	*2.38 Oz		*2.49 oz		*18.0	400
Observe Efficiency(per cent)	75	75	75	75	95		87		85	60
Actual or Observed Production/shift	99	33	33	33	2.27		2.17		15.4	240
Required Daily Production(300 days)	91	91	88	86	83		80		79	[illegible]

MACHINE REQUIREMENT

Based on 1 shift

	Beater (Opener)	Poorva Pesai	Carding	Drawing (Uttar Pesai)	Roving: Ambar charka		Spinning: Ambar Charka		Reeling (By Charka)	Bundle Press
No.of Machines(or spindles)	1	3	3	3x3=9	4x10=40	4x8=32	6x110=660	12x4. =552	6	1
Production Capacity	99	99	99	99	91	97	89	89	92	240

POWER

	Beater (Opener)	Poorva Pesai	Carding	Drawing (Uttar Pesai)	Roving: Ambar charka		Spinning: Ambar Charka		Reeling (By Charka)	Bundle Press
Installed Power/machine(Kw)	0.5	0.5	0.5	0.5	-	-	-	-	-	-
Total Installed Power(1 shift)	0.5	1.5	1.5	1.5	-	-	-	-	-	-

* Maximum observed production

Source: Own survey from the Khadi Centres(Ahmedabad & Calcutta), Rural Fabric Centre(Coimbatore), India and Charka and Cottage Industries Organisation(Comilla), Bangladesh.

Finally, identical to the intermediate RFC spinning, three 'Drawing' operation have been considered to improve the quality of the output.

Space Requirement

The factory shed and the total area of the KVIC spinning unit are shown in appendix 5.14. It shows that they require 332 and 457 sq. metres respectively. The factory shed area necessary for the 240 units is 79,680 sq.metres which is about five and ten times larger than the modern and the intermediate technologies respectively. The total area for the 240 units is 109,680 sq.metres which is nine and four times larger than the modern and the intermediate technologies.

Manning Level

The manning level of the different sub-processes have been estimated from the KVIC units in India and from the only unit in Bangladesh which uses KVIC technology on an experimental basis. The sub-process manning level required for a single and for 240 units have been shown in appendix 5.15, while table 5.11 shows the administrative staff requirement and summarises the maintenance and workshop personnel with their skill composition.

TABLE 5.11

Manning Level of KVIC Hand Spinning

Types of Employment	Employment[a/] S	US2	US3	AS	Total	Unit	Total Empnt.
Production	1	1	15	126	143	240	34,320
Supervisor (Prodn+Maint.)	1	-	-	-	1	240	240
Management	-	-	-	-	2	240	480
Total	2	1	15	126	146	240	35,040

Note : a/ S : Skilled; US2 and US3 : Un-skilled (type 2 and 3); and AS: Ambar Hand Spinner

Source: KVIC Units(Coimbatore, Ahmedabad and Calcutta), India

It appears that each unit requires 143 direct production workers, one production and maintenance supervisor and two accountants and managers i.e a total employment of 147. The total employment of 240 units would be 35,280 which when compared with the modern and the intermediate technologies embodies about 35 and 7 fold increase.

Power Requirement

It is the pre-spinning machinery which only consumes power, while the other sub-processes are hand-operated. The other power requirements are for the lighting of the factory and of the managers' quarters. The installed power of the machinery has been adjusted by a factor of 0.8. Appendix 5.16 gives the installed and absorbed power of the preparatory machinery and lighting for single and 240 units. The appendix indicates that the annual per unit power requirement is 15.6o thousand Kwh, therefore, for 240 units to attain the comparable output level (Q) it is 3.74 million Kwh which is one-third of the consumption of the RFC power spinning and only 2 per cent more than the ATDA Pedal spinning requirements. Finally, the KVIC requires between 37 to 42 per cent of the power requirements of the modern spinning technologies of Japanese, Rumanian, Indian and the UK sources.

TRADITIONAL TECHNOLOGY(HANDLOOM WEAVING)

Unlike the previous technologies, the handloom preparatory sub-processes are accomplished by a large content of operatives and the use of equipment is scarce and primitive (see appendix 4.X). The selection of the number of equipment and looms required to attain the comparable scale of output,therefore, depends on the production capacity of the operatives as well. The production capacities of the equipment vary according to the age and skill of the operatives and the location of the units. Bobbin making, for example, are usually done by children aged 6 and 7 and by elderly members of the family who work more often on part-time basis either on family units or hire themselves out. The weighted mean production of the preparatory sub-process equipment ,handlooms and their operatives have been estimated from a survey of 214 haddloom cottage weavers at various locations in Bangladesh. However, more importance was attached to the weaving production of the two types of looms widely in use in Bangladesh; Pit and Semi-automatic (C.R) looms.

Appendix 5.18 shows the daily and per shift weighted mean production of Pit and C.R looms. The daily production measures the maximum production which can be accomplished by a weaver in a day. It was difficult to ascertain the daily working hours, as a weaver may start working at six in the morning and finish at 10 at night,but within this period he may take time off on several occasion.The maximum level of production is achieved during the winter (Oct. to Feb.) when the demand for the product rises . However,during the monsoons (April to August) production falls to a minimum as the weavers may often engage themselves in agricultural work. The survey was conducted between August to November, which is the period when the production picks up from its minimum level to the maximum. It is observed that the weavers mostly work for 7 to 9 hours during this time,unlike in the monsoon and the winter seasons when they may work for 4 to 6 and 9 to 12 hours respectively. The production capacity at the time of the survey can be a representation of the average production. The survey shows a weighted mean production for Bangladesh on daily and shift basis,which for Pit looms is 11.12 yds. and 8.71 yds and for Semi-sutomatic looms, 16.45 yds. and 11.32 yds. respectively. Therefore,the shift production of the Pit and C.R looms are 78 and 70 per cent of their daily productions. For the purpose of this study,the shift production of the Pit and C.R looms have been assumed to at an average level throughout the year. The number of looms required to attain the comparable level of output (Q) would be based on the shift production .

Table 5.12 shows the number of equipment and looms required for the pre-weaving and weaving sub-processes. As the handlooms are dispersedly located it would be appropriate to estimate the total requirement of equipment rather than for a single unit the average size of which is 2.2 looms/unit. The quantity of material required to be processed at each sub-process level are calculated for the input (yarn) supplied,either from the modern,intermediate or the KVIC technologies. The procedure employed for the selection of equipment and looms required is identical to the previous. Table 5.12 shows that about 13,824 Pit and 10,636 C.R looms would be required to arrive at the comparable scale of output (Q).

Space Requirement

An attempt has been made to estimate the area require based on the floor space for the Pit and RC.R looms and preparatory equipment. Among preparatory equipment ,only the 'Drum' which makes the warp-beam is placed under the shed,while the other preparatory operations are performed in an open or a utility area. 8/ Appendix 5.14 gives the total area required by handloom weaving using Pit and C.R looms which is composed of the shed for the looms and the preparatory equipment and the utility area. The utility area has been taken to be 10 per cent of the total area. The total area required for Pit and C.R loom production was found to be 82,282 and 89,204 sq,metres respectively.

TABLE 5.12

Traditional Handloom Sector

PRODUCTION PLAN OF PIT AND C.R. LOOM.

(All in lbs)

	Bobbin Winding and Sizing (Pre-warping)	Natai and Tana (Warping)	Drum (Beaming)	Nali (Pirn Winding)	Tant (Loom) Pit Loom	Chittaranjan Loom (Semi-Auto)
Maximum Observed Production/day/shift	4.2	10	20	4.0	12.27	14.55
Observed Efficiency (per cent)	83	82	82	86	71	78
Average Observed Prodn./day/shift	3.5	8.25	16.5	3.44	8.71	11.32
Required Daily Prodn (300 days)	9,955	9,760	9,663	9,544	111,390	111,390
Machine or Equipment Requirement						
No. of Machine or Equipment	2860		590	2,790	13,824	10,636
Productive Capacity	10,010		9,735	9,598	120,410	120,400

SOURCE : Own survey conducted on 214 cottage weavers in different areas of Bangladesh.

Manning Level

The manning requirement of the Pit and C.R looms preparatory weaving have been shown in table 5.13 which are identical for both the looms except for Sana and Ba (Drawing-in) where the C.R loom has lower employment because of larger warp length. The total manning required by the Pit and C.R loom weaving to attain the a level of ouput comparable with modern and intermediate technologies are 21,844 and 18,397 respectively. The Pit loom, therefore, requires about 16 per cent more labour force than the C.R loom weaving. This difference is due to the higher productivity of the C.R looms which involve less looms to produce the same level of output.

It would be useful to combine the manning level of the handloom weaving with those of the modern spinning and the Service Centre; ATDA(Roving) and Pedal spinning; and finally with the KVIC spinning to ascertain the total manning requirement of the alternative technologies. Table 5.14 gives the total manning requirement of these technologies. It shows that the modern spinning ,Service Centre and the Pit or C.R looms would have manning level either between 18,850 to 18,924 and 15,403 to 15,472 depending on the source of the modern spinning technology i.e UK, Japan,India and Rumania. The manning level of the ATDA (Roving) and Pedal spinning with either Pit or C.R loom would be either 30,194 or 30,747. Finally,if KVIC technology is combined with Pit and C.R looms ,the manning level would be either 56,884 or 53,677. The manning level has increased progressively for the technologies described above. It appears that the ATDA (Roving) , Pedal spinning and the Pit or C.R loom would require 86 and 103 per cent more manning than the modern spinning and the Service Centre. While the KVIC spinning and the Pit or C.R loom would require about 310 and 355 percent more than the former and about 67.5 and 75 per cent than the latter technologies .

TABLE 5.13

Employment in the Traditional Handloom Sector

Sub-process Loom Type/Employment	Bobbin	Natai & Tana (Sizing&Warping)	Drum (Beaming)	Nali (Pirn Winding)	Sana & Ba (Drawing in)	Weaving	Total Employment
Pit loom	2,860	1,180	586	2,790	604	13,824	21,844
Semi-auto(C.R) looms	2,860	1,180	586	2,790	345	10,636	18,397

TABLE 5.14

Total Employment for Combined Handloom Technologies

Technology Types

Modern Service Spinning/Centre/Handloom

	Pit Loom	C.R.Loom
Modern Spg.1/	972-1,046	972-1,046
Service Centre	660	660
Handloom 2/	17,218	13,771
TOTAL EMPLOYMENT	18,850-18,924	15,403-15,477

ATDA Pedal Pre-Spg./Spg. /Handloom

	Pit Loom	C.R.Loom
ATDA(Roving)	1,510	1,510
Pedal Spg.	10,840	10,840
Handloom	21,844	18,397
TOTAL EMPLOYMENT	34,194	30,747

KVIC SPG./Handloom

	Pit Loom	C.R.Loom
KVIC Spg.	35,040	35,280
Handloom	21,844	18,397
TOTAL EMPLOYMENT	56,884	53,677

1/ Employment variation is due to the alternative sources of technologies from UK, Japan, India and Rumania.

2/ Employment contains handloom weavers and nali makers(pirn winders) and Sana and Ba(Drawing in)

Sources: The employment for handloom has been based on a survey conducted on 214 handloom weavers in Bangladesh.

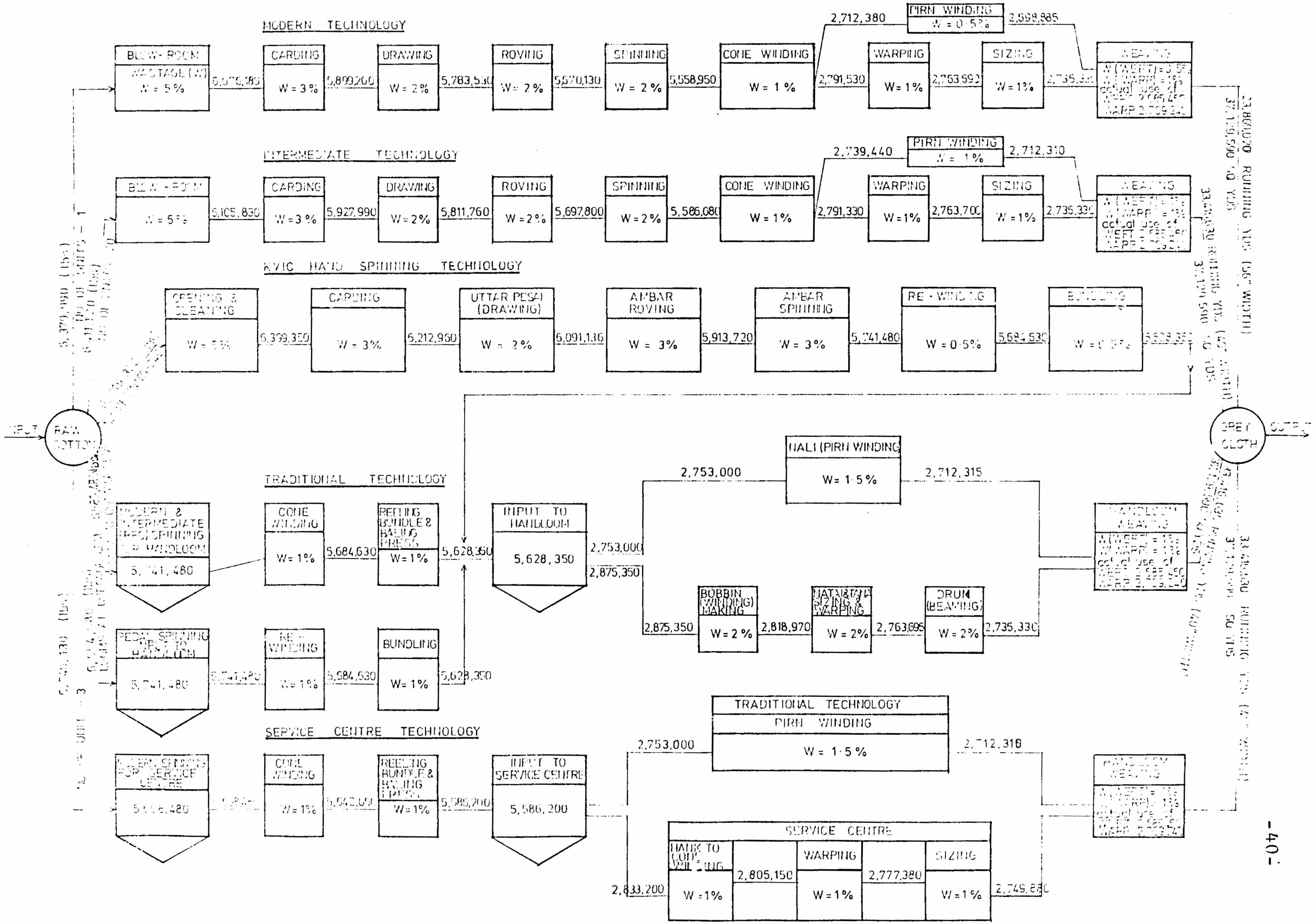
Input-Output Balancing of Alternative Technologies

The previous sections have dealt in details with the number of machinery required by the modern, intermediate and the traditional technologies in order to attain the comparable scale of output (Q). It has been seen that while selecting machinery, emphasis had been put on maintaining the output-level of all the alternative technologies at the same level. In this section, it has been attempted to balance the alternatives by fixing the annual comparable scale of output (Q) at 37.13 million square yards. This takes into consideration the different sub-process wastage of modern, intermediate and traditional technologies, the input and output of the sub processes and finally draws a relationship between input and output. Table 5.15 shows the input-output balancing of the production units of the alternative technologies identified earlier.

The table shows that the output of all the technologies are the same i.e 37.13 million sq.yd. However , in terms of running yard, the production levels are different, example, 23.87 million sq. yards for modern technology for the cloth width of 56 inches, but for intermediate and traditional technologies, it is 34.42 sq. yards for a cloth width of 40 inches. To meet this output level, 1 modern, 20 intermediate (RFC and ATDA) and 240 KVIC units would be required. The raw-cotton input of the different alternatives vary according to the sub-process wastage levels. The raw-cotton input for the modern composite unit is 6.38 million lbs., but when the modern spinning unit supplies yarn to the Service Centre and the Handloom , the raw-cotton inputs are 6.54 and 6.59 million lbs i.e the input requirement for the latter increases by 2.52 and 3.30 per cent respectively. The intermediate technology (RFC) on the other hand, requires raw-cotton input of 6.41 million lbs. for the pedal and the power loom composite units, which is about 0.5 per cent higher than the modern composite unit. However, it requires an identical amount of raw-cotton when supplying yarn to the handloom weavers, as the wastage level for both the technologies have been taken

FIGURE 5.1

INPUT - OUTPUT BALANCING FOR ALTERNATIVE TECHNOLOGIES



-40-

to be identical . The ATDA pedal and the KVIC hand spinning require raw-cotton input of 6.65 and 6.72 million lbs. respectively, when supplying yarn to the handloom weavers. The ATDA pedal/spinning needs 4.23 and 3.75 per cent more raw material than the modern and the RFC composite technologies, and about 1 per cent more when these units are supplying yarn to the handloom weavers. The KVIC hand-spinning requires 2.75 , 4.84 and 5.33 per cent more raw-cotton than the/Service Centre modern and the RFC composite technologies . When all the technologies are supplying yarn to the handloom weavers, the KVIC hand-spinning requires about 1.05 per cent more raw-cotton than the modern and the RFC spinning and about 1.01 per cent more than the ATDA pedal spinning. It, therefore appears that the KVIC spinning requires the highest level of input followed by the ATDA pedal, RFC/power and the modern spinning technologies. As regards the composite unit, the modern technology requires the lowest level of raw-cotton followed by the RFC composite and the handloom weaving.

NOTES (Chapter-4)

1/ In the UK very few textile manufacturers at present make pre-paratory weaving machinery. Enquiries revealed that most of the machinery in the UK markets come from the USA.

2/ A manufacturer in Rumania and its local agents in Bangladesh had been contacted but no information could be obtained.

3/ At a later stage of this study , the prices of the Indian machinery were found , but the difference in these prices were insignificant i.e about 5 to 8 per cent.

4/ A similar kind of loom viz. C.R((Semi-auto) loom is widely used in Bangladesh. A survey of these looms has estimated their average production at 11.32 yards per day, which is identical to that of the Indian Pedal loom. Therefore, the Pedal loom will attain the Indian level of production under Bangladesh condition.

5/ <u>Small Scale Textile Industry</u>, by Mia Alam, M.S., published by the Micro Industries Development Assistance Society, Dhaka, Bangladesh, 1981. pp. 7-9 and 17.

6/ <u>Recommendation for a Co-operative Development Programme for the Handloom Weaving Industry in Bangladesh</u>, by Maldonado,A., I.L.O., June. 1976. pp. 15-17.

7/ Field investigation shows that there are some handloom weavers who can barely manage to buy yarn for 40 yds. of warp-beam.

8/ Discussion with the local machine manufacturer indicates that it is possible to make such machine locally at a cost used later.

9/ Utility areas include some extra spaces within the weaving shed, where operations like Bobbin making, Pirn winding and other preparatory weaving can be performed.